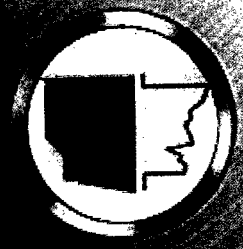
Cimarex Energy Company
Estill AD Fed #2

Completion Profiler



Completion Profile Analysis

Company	*Cimarex Energy Company*
Well Name	*Estill AD Fed #2*
Field	*White City Penn*
Location	*Eddy County, New Mexico*
Customer Name	*Steven A. Runyan*
Date of Survey	*July 28, 2017*
Date of Analysis	*August 14, 2017*
Logging Engineer	*Paulo Rios*
Analyst	*Derrick George*

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Survey Objectives

- Identify gas producing intervals.
- Identify oil producing intervals.
- Identify the source of water production.
- Quantitative production profile.

Logging Procedures

Date	Time	Comment
07/28	07:30	Arrive on location
07/28	08:20	Gauge run start
07/28	09:45	Gauge run stop
07/28	09:57	Program Completion Profile String
07/28	10:48	Start GIH pass
07/28	11:23	Stop GIH pass
07/28	11:43	Start logging passes
07/28	12:44	Stop logging passes
07/28	12:45	Start out of well pass
07/28	13:30	Stop out of well pass
07/28	13:35	Start download
07/28	13:55	Stop download
07/28	15:00	Rig down

Interval Logged: [From 8,400 to 9,730 ft.]
60 ft/min

Well Information

Casing: 4.500" 11.6 lb/ft surface to 12,300 ft PBTD: 10,365 ft

Tubing: 2.375" 4.7 lb/ft surface to 8,390 ft

Perforations:

Perforation Data																							
Stage 6 - Wolfcamp																							
8,418	to	8,419	8,432	to	8,433	8,442	to	8,443	8,456	to	8,457	8,476	to	8,477									
8,504	to	8,505	8,516	to	8,517	8,534	to	8,535	8,548	to	8,549	8,562	to	8,563									
8,572	to	8,573	8,582	to	8,583	8,595	to	8,596	8,602	to	8,603	8,611	to	8,612									
8,618	to	8,619	8,630	to	8,631	8,645	to	8,647	8,664	to	8,666	8,672	to	8,675									
Stage 5 - Wolfcamp																							
8,989	to	8,990	9,000	to	9,001	9,010	to	9,011	9,018	to	9,019	9,025	to	9,026									
9,032	to	9,033	9,042	to	9,043	9,051	to	9,052	9,066	to	9,067	9,084	to	9,085									
9,101	to	9,102	9,176	to	9,177	9,188	to	9,189	9,197	to	9,198	9,212	to	9,213									
9,227	to	9,228	9,247	to	9,248	9,258	to	9,260	9,270	to	9,272	9,286	to	9,290									
Stage 4 - Wolfcamp																							
9,310	to	9,311	9,318	to	9,319	9,327	to	9,328	9,335	to	9,336	9,343	to	9,344									
9,352	to	9,353	9,359	to	9,360	9,369	to	9,370	9,383	to	9,384	9,390	to	9,391									
9,400	to	9,401	9,407	to	9,408	9,415	to	9,416	9,422	to	9,423	9,430	to	9,431									
9,440	to	9,441	9,455	to	9,456	9,468	to	9,470	9,480	to	9,482	9,490	to	9,493									
Stage 3 - Wolfcamp																							
9,575	to	9,576	9,582	to	9,583	9,594	to	9,595	9,599	to	9,600	9,614	to	9,615									
9,624	to	9,625	9,636	to	9,637	9,643	to	9,644	9,651	to	9,652	9,658	to	9,659									
9,672	to	9,673	9,686	to	9,687	9,694	to	9,695	9,705	to	9,706	9,713	to	9,714									
9,725	to	9,726	9,734	to	9,736																		
Stage 2 - Wolfcamp																							
9,756	to	9,757	9,764	to	9,765	9,775	to	9,776	9,782	to	9,783	9,788	to	9,789									
9,800	to	9,801	9,811	to	9,812	9,820	to	9,821	9,827	to	9,828	9,834	to	9,835									
9,844	to	9,845	9,861	to	9,862	9,872	to	9,873	9,884	to	9,885	9,894	to	9,895									
9,905	to	9,906	9,913	to	9,915																		
Stage 1 - Cisco Canyon																							
9,981	to	9,982	10,022	to	10,023	10,079	to	10,080	10,099	to	10,100	10,128	to	10,129									
10,144	to	10,145	10,170	to	10,171	10,195	to	10,196	10,213	to	10,215												

Tool String

The 1.70" Completion Profiler string comprised the following sensors:

Battery housing; RS-232/CCL; Memory/CPU; Gamma Ray; Pressure/Temperature Combo; Centralizer; Induction Collar Locator; Fluid Density; Fluid Dielectric; Centralizer; Spinner Flowmeter.

Results

The following table summarizes the production from each frac stage.

MEASURED SURFACE RATES Flow Rates Reported at STP									
	Tubing	Gas			Oil			Water		
	Psi	MCFD			BFPD			BFPD		
Avg	300 psi	1261 Mcf/d			105 bpd			429 bpd		

GAS / OIL / WATER PRODUCTION PROFILE Flow Rates Reported at STP										
Zone Intervals feet	Q-Gas MCFD	Qp-Gas MCFD	Percent of Total	Q-Oil BFPD	Qp-Oil BFPD	Percent of Total	Q-Water BFPD	Qp-Water BFPD	Percent of Total
Surface to 8418	1264.3 Mcf/d		100.00 %	105.13 bpd		100.00 %	427.88 bpd		100.00 %
Stage 6 - Wolfcamp			26.90 %			26.90 %			69.73 %
8418 to 8675	1264.3 Mcf/d	340.1 Mcf/d		105.13 bpd	28.28 bpd		427.88 bpd	298.36 bpd	
Stage 5 - Wolfcamp			22.28 %			22.28 %			25.81 %
8989 to 9290	924.3 Mcf/d	281.7 Mcf/d		76.85 bpd	23.43 bpd		129.52 bpd	110.44 bpd	
Stage 4 - Wolfcamp			26.97 %			26.97 %			1.54 %
9310 to 9493	642.5 Mcf/d	341.0 Mcf/d		53.43 bpd	28.36 bpd		19.07 bpd	6.61 bpd	
Stage 3 - Wolfcamp			6.70 %			6.70 %			1.01 %
9575 to 9726	301.5 Mcf/d	84.7 Mcf/d		25.07 bpd	7.05 bpd		12.47 bpd	4.32 bpd	
Flow Contribution from Below Log Depth			17.15 %			17.14 %			1.91 %
9730 to Below	216.8 Mcf/d		17.15 %	18.02 bpd		17.14 %	8.15 bpd		1.91 %

The following table summarizes the production from each producing interval.

GAS / OIL / WATER PRODUCTION PROFILE Flow Rates Reported at STP										
Zone Intervals feet		Q-Gas MCFD	Qp-Gas MCFD	Percent of Total	Q-Oil BFPD	Qp-Oil BFPD	Percent of Total	Q-Water BFPD	Qp-Water BFPD	Percent of Total
Surface to 8418		1264.3 Mcf/d		100.00 %	105.13 bpd		100.00 %	427.88 bpd		100.00 %
Stage 6 - Wolfcamp				26.90 %			26.90 %			69.73 %
8418 to 8419		1264.3 Mcf/d	229.9 Mcf/d	18.19 %	105.13 bpd	19.12 bpd	18.19 %	427.88 bpd	15.62 bpd	3.65 %
8432 to 8433		1034.4 Mcf/d	2.8 Mcf/d	0.22 %	86.01 bpd	0.23 bpd	0.22 %	412.27 bpd	24.43 bpd	5.71 %
8442 to 8443		1031.6 Mcf/d	3.4 Mcf/d	0.27 %	85.78 bpd	0.28 bpd	0.27 %	387.84 bpd	14.36 bpd	3.36 %
8456 to 8457		1028.2 Mcf/d	2.8 Mcf/d	0.22 %	85.49 bpd	0.23 bpd	0.22 %	373.47 bpd	5.84 bpd	1.36 %
8476 to 8477		1025.4 Mcf/d	2.4 Mcf/d	0.19 %	85.26 bpd	0.20 bpd	0.19 %	367.64 bpd	64.72 bpd	15.13 %
8504 to 8505		1023.0 Mcf/d	3.6 Mcf/d	0.29 %	85.06 bpd	0.30 bpd	0.29 %	302.91 bpd	17.43 bpd	4.07 %
8516 to 8517		1019.4 Mcf/d	2.9 Mcf/d	0.23 %	84.76 bpd	0.24 bpd	0.23 %	285.48 bpd	10.50 bpd	2.45 %
8534 to 8535		1016.5 Mcf/d	3.1 Mcf/d	0.25 %	84.52 bpd	0.26 bpd	0.25 %	274.98 bpd	8.33 bpd	1.95 %
8548 to 8549		1013.4 Mcf/d	2.8 Mcf/d	0.22 %	84.26 bpd	0.23 bpd	0.22 %	266.65 bpd	32.65 bpd	7.63 %
8562 to 8563		1010.7 Mcf/d	2.8 Mcf/d	0.22 %	84.03 bpd	0.23 bpd	0.22 %	234.00 bpd	12.73 bpd	2.98 %
8572 to 8573		1007.8 Mcf/d	2.7 Mcf/d	0.21 %	83.80 bpd	0.22 bpd	0.21 %	221.26 bpd	10.54 bpd	2.46 %
8582 to 8583		1005.2 Mcf/d	3.4 Mcf/d	0.27 %	83.58 bpd	0.28 bpd	0.27 %	210.73 bpd	4.42 bpd	1.03 %
8595 to 8596		1001.8 Mcf/d	3.1 Mcf/d	0.25 %	83.30 bpd	0.26 bpd	0.25 %	206.31 bpd	12.89 bpd	3.01 %
8602 to 8603		998.7 Mcf/d	2.9 Mcf/d	0.23 %	83.04 bpd	0.25 bpd	0.23 %	193.41 bpd	10.97 bpd	2.57 %
8611 to 8612		995.7 Mcf/d	2.9 Mcf/d	0.23 %	82.79 bpd	0.25 bpd	0.23 %	182.44 bpd	6.47 bpd	1.51 %
8618 to 8619		992.8 Mcf/d	40.0 Mcf/d	3.16 %	82.55 bpd	3.32 bpd	3.16 %	175.97 bpd	3.85 bpd	0.90 %
8630 to 8631		952.8 Mcf/d	21.7 Mcf/d	1.71 %	79.23 bpd	1.80 bpd	1.71 %	172.12 bpd	11.79 bpd	2.76 %
8645 to 8647		931.2 Mcf/d	1.8 Mcf/d	0.15 %	77.43 bpd	0.15 bpd	0.15 %	160.33 bpd	8.12 bpd	1.90 %
8664 to 8666		929.3 Mcf/d	2.8 Mcf/d	0.22 %	77.27 bpd	0.23 bpd	0.22 %	152.21 bpd	6.83 bpd	1.60 %
8672 to 8675		926.6 Mcf/d	2.3 Mcf/d	0.18 %	77.04 bpd	0.19 bpd	0.18 %	145.38 bpd	15.86 bpd	3.71 %
Stage 5 - Wolfcamp				22.28 %			22.28 %			25.81 %
8989 to 8990		924.3 Mcf/d	7.6 Mcf/d	0.60 %	76.85 bpd	0.63 bpd	0.60 %	129.52 bpd	5.57 bpd	1.30 %
9000 to 9001		916.7 Mcf/d	7.5 Mcf/d	0.60 %	76.22 bpd	0.63 bpd	0.60 %	123.95 bpd	7.91 bpd	1.85 %
9010 to 9011		909.1 Mcf/d	7.5 Mcf/d	0.59 %	75.59 bpd	0.62 bpd	0.59 %	116.04 bpd	7.74 bpd	1.81 %
9018 to 9019		901.6 Mcf/d	7.6 Mcf/d	0.60 %	74.97 bpd	0.63 bpd	0.60 %	108.30 bpd	5.58 bpd	1.31 %
9025 to 9026		894.0 Mcf/d	7.6 Mcf/d	0.60 %	74.33 bpd	0.63 bpd	0.60 %	102.72 bpd	3.21 bpd	0.75 %
9032 to 9033		886.4 Mcf/d	8.4 Mcf/d	0.67 %	73.71 bpd	0.70 bpd	0.67 %	99.51 bpd	8.04 bpd	1.88 %
9042 to 9043		878.0 Mcf/d	7.1 Mcf/d	0.57 %	73.00 bpd	0.59 bpd	0.57 %	91.47 bpd	4.57 bpd	1.07 %
9051 to 9052		870.9 Mcf/d	7.1 Mcf/d	0.56 %	72.41 bpd	0.59 bpd	0.56 %	86.89 bpd	5.27 bpd	1.23 %
9066 to 9067		863.7 Mcf/d	2.7 Mcf/d	0.21 %	71.82 bpd	0.22 bpd	0.21 %	81.63 bpd	10.11 bpd	2.36 %
9084 to 9085		861.1 Mcf/d	2.7 Mcf/d	0.21 %	71.60 bpd	0.22 bpd	0.21 %	71.52 bpd	4.29 bpd	1.00 %
9101 to 9102		858.4 Mcf/d	2.7 Mcf/d	0.21 %	71.37 bpd	0.22 bpd	0.21 %	67.23 bpd	5.38 bpd	1.26 %
9176 to 9177		855.7 Mcf/d	3.4 Mcf/d	0.27 %	71.15 bpd	0.28 bpd	0.27 %	61.85 bpd	4.98 bpd	1.16 %
9188 to 9189		852.3 Mcf/d	3.7 Mcf/d	0.29 %	70.87 bpd	0.31 bpd	0.29 %	56.88 bpd	3.97 bpd	0.93 %
9197 to 9198		848.6 Mcf/d	3.5 Mcf/d	0.28 %	70.56 bpd	0.29 bpd	0.28 %	52.91 bpd	1.91 bpd	0.45 %
9212 to 9213		845.1 Mcf/d	3.6 Mcf/d	0.29 %	70.27 bpd	0.30 bpd	0.29 %	51.00 bpd	5.10 bpd	1.19 %
9227 to 9228		841.5 Mcf/d	3.4 Mcf/d	0.27 %	69.97 bpd	0.28 bpd	0.27 %	45.90 bpd	3.62 bpd	0.85 %
9247 to 9248		838.1 Mcf/d	2.4 Mcf/d	0.19 %	69.69 bpd	0.20 bpd	0.19 %	42.27 bpd	3.57 bpd	0.84 %
9258 to 9260		835.7 Mcf/d	20.0 Mcf/d	1.59 %	69.49 bpd	1.67 bpd	1.59 %	38.70 bpd	2.98 bpd	0.70 %
9270 to 9272		815.7 Mcf/d	6.4 Mcf/d	0.51 %	67.82 bpd	0.53 bpd	0.51 %	35.72 bpd	2.93 bpd	0.68 %
9286 to 9290		809.2 Mcf/d	166.7 Mcf/d	13.18 %	67.29 bpd	13.86 bpd	13.18 %	32.79 bpd	13.72 bpd	3.21 %

Stage 4 - Wolfcamp				**26.97 %**			**26.97 %**			**1.54 %**
9310 to **9311**	**642.5 Mcf/d**	**4.7 Mcf/d**	**0.37 %**	53.43 bpd	0.39 bpd	**0.37 %**	19.07 bpd	1.44 bpd	**0.34 %**
9318 to **9319**	**637.9 Mcf/d**	**4.1 Mcf/d**	**0.33 %**	53.04 bpd	0.34 bpd	**0.33 %**	17.64 bpd	0.28 bpd	**0.07 %**
9327 to **9328**	**633.7 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.69 bpd	0.12 bpd	**0.12 %**	17.36 bpd	0.27 bpd	**0.06 %**
9335 to **9336**	**632.2 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.57 bpd	0.12 bpd	**0.12 %**	17.09 bpd	0.26 bpd	**0.06 %**
9343 to **9344**	**630.8 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.45 bpd	0.12 bpd	**0.12 %**	16.83 bpd	0.27 bpd	**0.06 %**
9352 to **9353**	**629.3 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.32 bpd	0.12 bpd	**0.12 %**	16.56 bpd	0.26 bpd	**0.06 %**
9359 to **9360**	**627.8 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.20 bpd	0.12 bpd	**0.12 %**	16.29 bpd	0.27 bpd	**0.06 %**
9369 to **9370**	**626.3 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	52.08 bpd	0.13 bpd	**0.12 %**	16.03 bpd	0.27 bpd	**0.06 %**
9383 to **9384**	**624.8 Mcf/d**	**1.5 Mcf/d**	**0.12 %**	51.95 bpd	0.12 bpd	**0.12 %**	15.76 bpd	0.28 bpd	**0.07 %**
9390 to **9391**	**623.3 Mcf/d**	**9.6 Mcf/d**	**0.76 %**	51.83 bpd	0.80 bpd	**0.76 %**	15.48 bpd	0.27 bpd	**0.06 %**
9400 to **9401**	**613.7 Mcf/d**	**23.3 Mcf/d**	**1.85 %**	51.03 bpd	1.94 bpd	**1.85 %**	15.21 bpd	0.28 bpd	**0.07 %**
9407 to **9408**	**590.4 Mcf/d**	**3.2 Mcf/d**	**0.25 %**	49.09 bpd	0.27 bpd	**0.25 %**	14.93 bpd	0.28 bpd	**0.07 %**
9415 to **9416**	**587.1 Mcf/d**	**3.2 Mcf/d**	**0.25 %**	48.82 bpd	0.26 bpd	**0.25 %**	14.65 bpd	0.27 bpd	**0.06 %**
9422 to **9423**	**584.0 Mcf/d**	**3.2 Mcf/d**	**0.25 %**	48.56 bpd	0.27 bpd	**0.25 %**	14.38 bpd	0.26 bpd	**0.06 %**
9430 to **9431**	**580.8 Mcf/d**	**2.6 Mcf/d**	**0.21 %**	48.29 bpd	0.22 bpd	**0.21 %**	14.12 bpd	0.28 bpd	**0.06 %**
9440 to **9441**	**578.1 Mcf/d**	**62.0 Mcf/d**	**4.90 %**	48.07 bpd	5.15 bpd	**4.90 %**	13.84 bpd	0.28 bpd	**0.07 %**
9455 to **9456**	**516.2 Mcf/d**	**27.9 Mcf/d**	**2.21 %**	42.92 bpd	2.32 bpd	**2.21 %**	13.56 bpd	0.28 bpd	**0.07 %**
9468 to **9470**	**488.3 Mcf/d**	**60.2 Mcf/d**	**4.76 %**	40.60 bpd	5.01 bpd	**4.76 %**	13.28 bpd	0.28 bpd	**0.07 %**
9480 to **9482**	**428.0 Mcf/d**	**118.7 Mcf/d**	**9.39 %**	35.59 bpd	9.87 bpd	**9.39 %**	13.00 bpd	0.27 bpd	**0.06 %**
9490 to **9493**	**309.4 Mcf/d**	**7.9 Mcf/d**	**0.62 %**	25.72 bpd	0.65 bpd	**0.62 %**	12.73 bpd	0.27 bpd	**0.06 %**
Stage 3 - Wolfcamp			**6.70 %**			**6.70 %**			**1.01 %**
9575 to **9576**	**301.5 Mcf/d**	**18.3 Mcf/d**	**1.45 %**	25.07 bpd	1.52 bpd	**1.45 %**	12.47 bpd	0.27 bpd	**0.06 %**
9582 to **9583**	**283.2 Mcf/d**	**0.6 Mcf/d**	**0.05 %**	23.55 bpd	0.05 bpd	**0.05 %**	12.20 bpd	0.27 bpd	**0.06 %**
9594 to **9595**	**282.6 Mcf/d**	**0.6 Mcf/d**	**0.04 %**	23.49 bpd	0.05 bpd	**0.04 %**	11.93 bpd	0.28 bpd	**0.07 %**
9599 to **9600**	**282.0 Mcf/d**	**0.5 Mcf/d**	**0.04 %**	23.45 bpd	0.04 bpd	**0.04 %**	11.65 bpd	0.26 bpd	**0.06 %**
9614 to **9615**	**281.5 Mcf/d**	**3.7 Mcf/d**	**0.29 %**	23.41 bpd	0.31 bpd	**0.29 %**	11.39 bpd	0.26 bpd	**0.06 %**
9624 to **9625**	**277.8 Mcf/d**	**4.2 Mcf/d**	**0.33 %**	23.10 bpd	0.35 bpd	**0.33 %**	11.13 bpd	0.27 bpd	**0.06 %**
9636 to **9637**	**273.6 Mcf/d**	**3.7 Mcf/d**	**0.29 %**	22.75 bpd	0.31 bpd	**0.29 %**	10.86 bpd	0.28 bpd	**0.07 %**
9643 to **9644**	**269.9 Mcf/d**	**3.2 Mcf/d**	**0.26 %**	22.44 bpd	0.27 bpd	**0.26 %**	10.58 bpd	0.28 bpd	**0.07 %**
9651 to **9652**	**266.7 Mcf/d**	**3.1 Mcf/d**	**0.25 %**	22.17 bpd	0.26 bpd	**0.25 %**	10.30 bpd	0.27 bpd	**0.06 %**
9658 to **9659**	**263.5 Mcf/d**	**3.7 Mcf/d**	**0.29 %**	21.91 bpd	0.31 bpd	**0.29 %**	10.03 bpd	0.26 bpd	**0.06 %**
9672 to **9673**	**259.9 Mcf/d**	**9.3 Mcf/d**	**0.73 %**	21.61 bpd	0.77 bpd	**0.73 %**	9.77 bpd	0.28 bpd	**0.07 %**
9686 to **9687**	**250.6 Mcf/d**	**9.0 Mcf/d**	**0.72 %**	20.84 bpd	0.75 bpd	**0.72 %**	9.50 bpd	0.28 bpd	**0.07 %**
9694 to **9695**	**241.5 Mcf/d**	**5.7 Mcf/d**	**0.45 %**	20.08 bpd	0.47 bpd	**0.45 %**	9.22 bpd	0.26 bpd	**0.06 %**
9705 to **9706**	**235.9 Mcf/d**	**6.6 Mcf/d**	**0.52 %**	19.61 bpd	0.55 bpd	**0.52 %**	8.96 bpd	0.27 bpd	**0.06 %**
9713 to **9714**	**229.3 Mcf/d**	**6.0 Mcf/d**	**0.48 %**	19.06 bpd	0.50 bpd	**0.48 %**	8.69 bpd	0.28 bpd	**0.07 %**
9725 to **9726**	**223.2 Mcf/d**	**6.4 Mcf/d**	**0.51 %**	18.56 bpd	0.54 bpd	**0.51 %**	8.41 bpd	0.26 bpd	**0.06 %**
Flow Contribution from Below Log Depth			**17.15 %**			**17.14 %**			**1.91 %**
9730 to **Below**	**216.8 Mcf/d**		**17.15 %**	18.02 bpd		**17.14 %**	8.15 bpd		**1.91 %**

Analysis Summary

1. The gauge ring tagged at ~9,917 feet. On the trip out of the hole, the gauge ring was dragging and ~700 pounds of added pull was needed to get the tool to a depth it moved freely. The logging tool tagged ~186 feet shallower than the gauge ring tool; at ~9,731 feet. On the trip out of the hole, the logging tool was also dragging and, again, ~700 pounds of added pull was needed to get the tool to a depth it moved freely. The company man on location made the call to end the logging run.

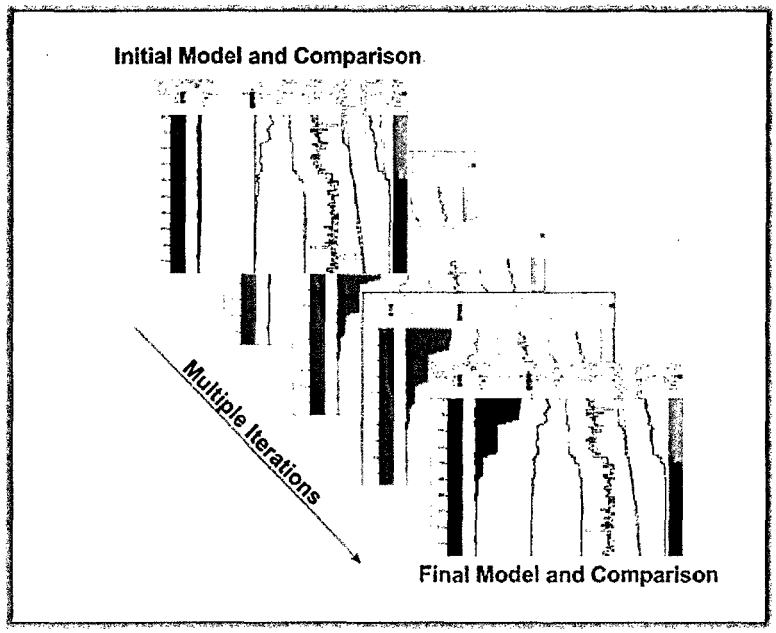
2. With having limited data to process, the confidence in this analysis is lower than normal.

3. The perforations below 9,730 feet were not logged due to wellbore restrictions. Total production from these intervals was calculated based on the data below the 9,725 - 9,726 feet perforations.

4. The analysis was conducted as 3-phase. The oil production of 105 BOPD is too low to accurately quantify. The downhole oil rate, at 100% flow, accounts for approximately 7% of the total mass flow and about 4.5% of the total volumetric rate, assuming free gas entry and solution gas breaking out downhole. The GOR is assumed to be even across all zones.

Brief Description of Process

The analysis is performed using a global stochastic optimization technique.
In this technique an initial flow model is estimated. Then from this model the theoretical log responses are derived. The theoretical responses are compared to all available data and the model is adjusted until the best possible match of the theoretical and actual data is obtained.



A comparison between the model responses and the recorded data is shown in this report. Good correlation between the theoretical and log data curves indicates that the flow model is in agreement with the log data and the actual well production profile. Discrepancies between the theoretical and raw data curves can be due to tool deficiencies, conflicts between the parameters or conditions that make the underlying empirical models (such as flow regimes) less applicable.

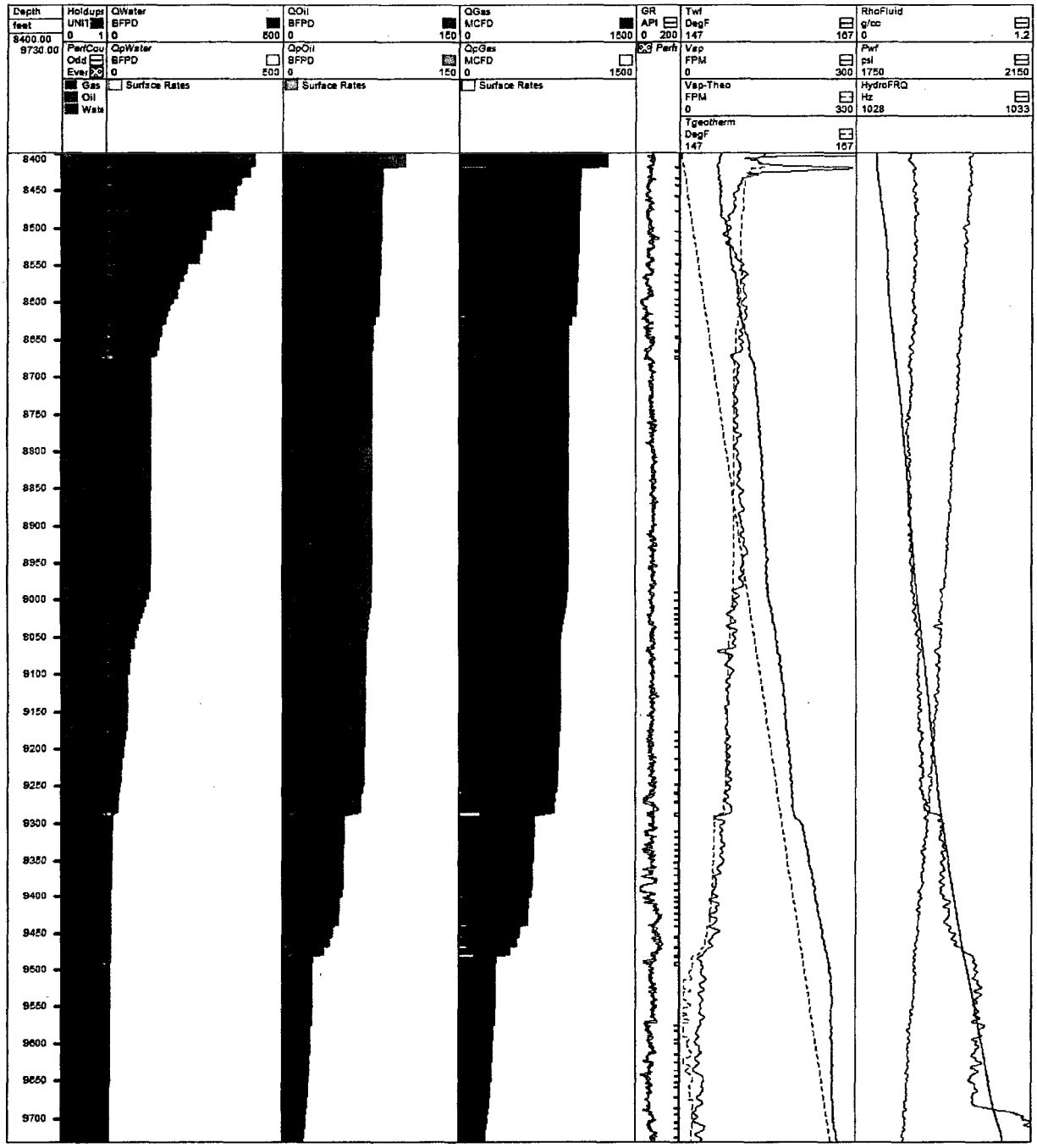
- The flow regimes were determined, directly from the flow rates and holdups, according to the Taitel-Dukler analytic model.
- The profile factors, to calculate the average effective fluid velocity from the apparent velocity, were based on the Reynolds number, calculated from the phase velocities and phase properties.
- Where gas was present the density, heat capacity and Joule-Thompson coefficients were derived from the Lee Kesler Pitzer equation of states.
- Solution gas in oil was derived from the Vasquez and Beggs or Oistein Glaso correlation

The analysis was performed in five steps:

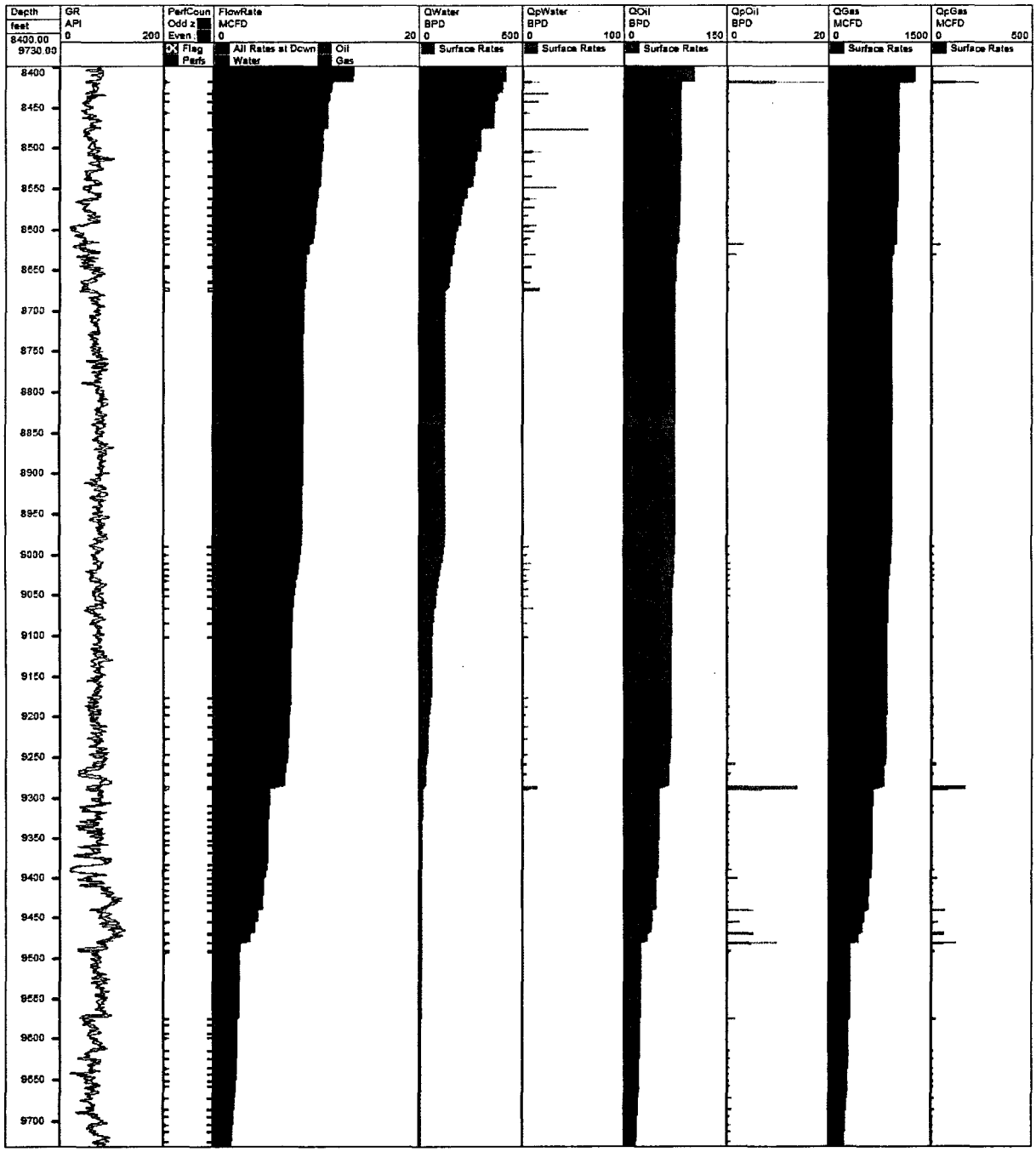
- The data preparation to filter the data, compute gradients and error estimates.
- The flow meter analysis to compute the apparent velocity.
- The profile determination to identify the potential producing and/or injecting zones.
- The computation of the flow rates (model) by global optimization.
- The computation of surface production rates and reporting

Completion Profile Analysis

Model Results With Recorded Data

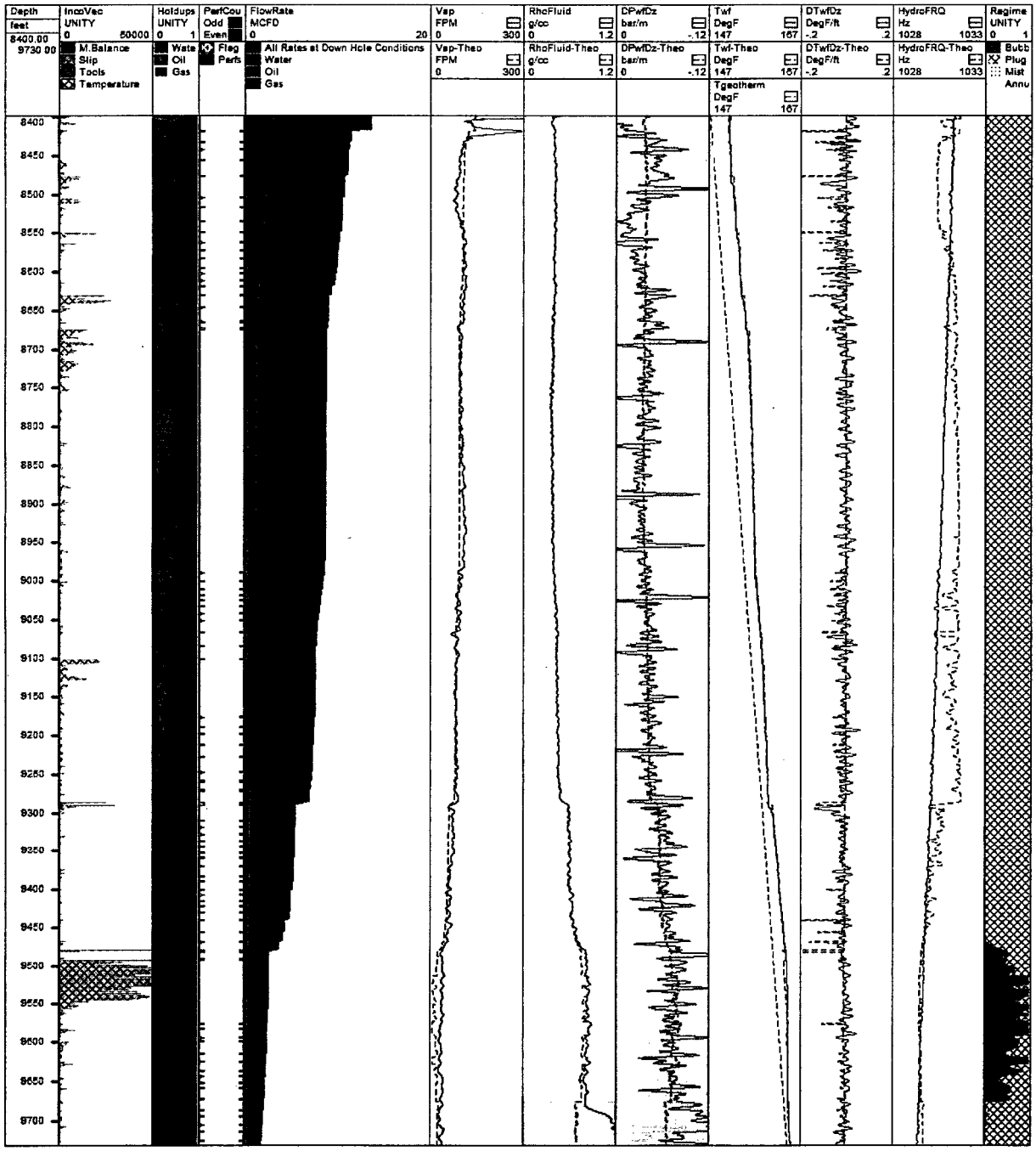


Production Rates At Surface Conditions



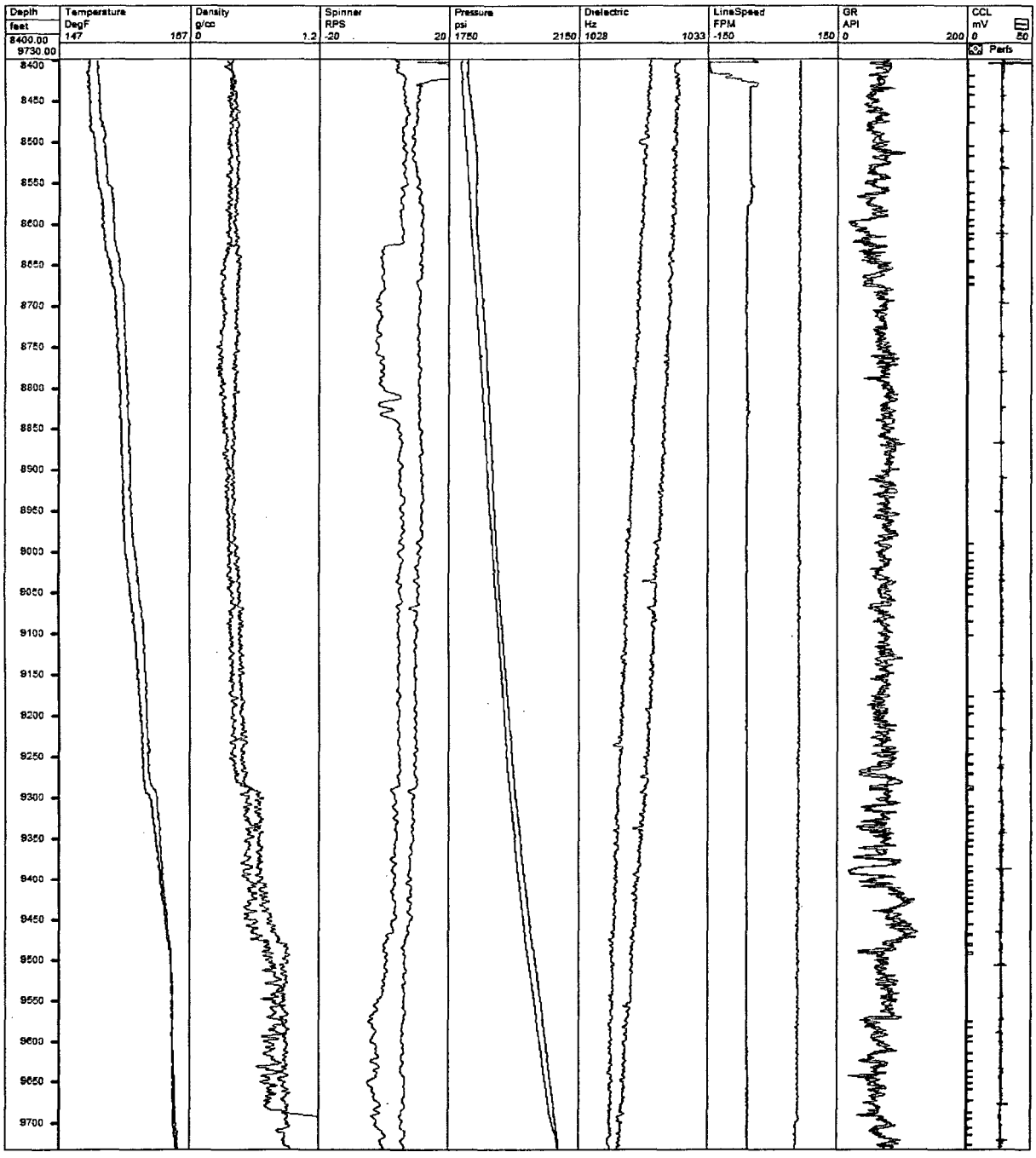
Completion Profile Analysis

Flow Model at Downhole Conditions With Comparison of Theoretical Response to Recorded Data

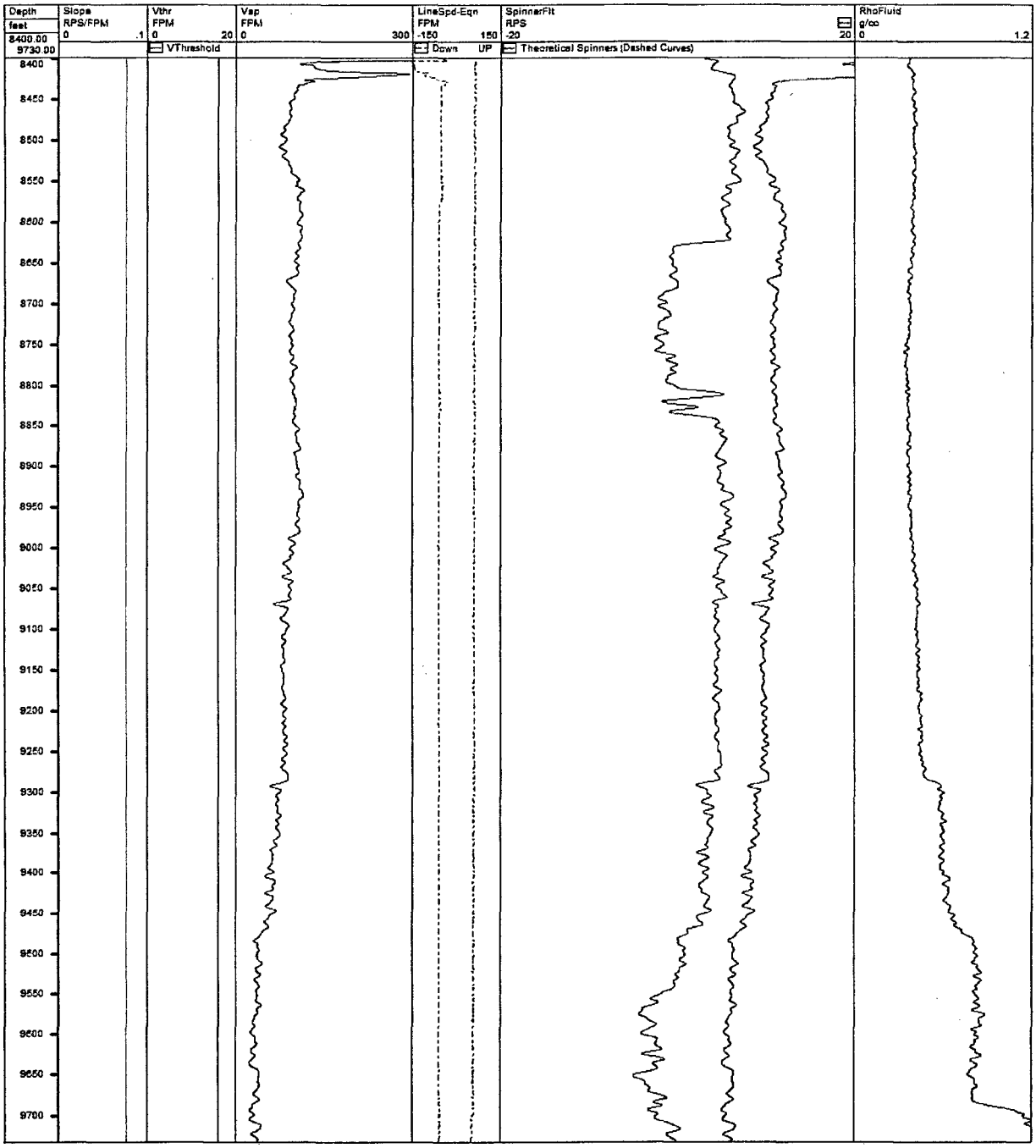


Completion Profile Analysis

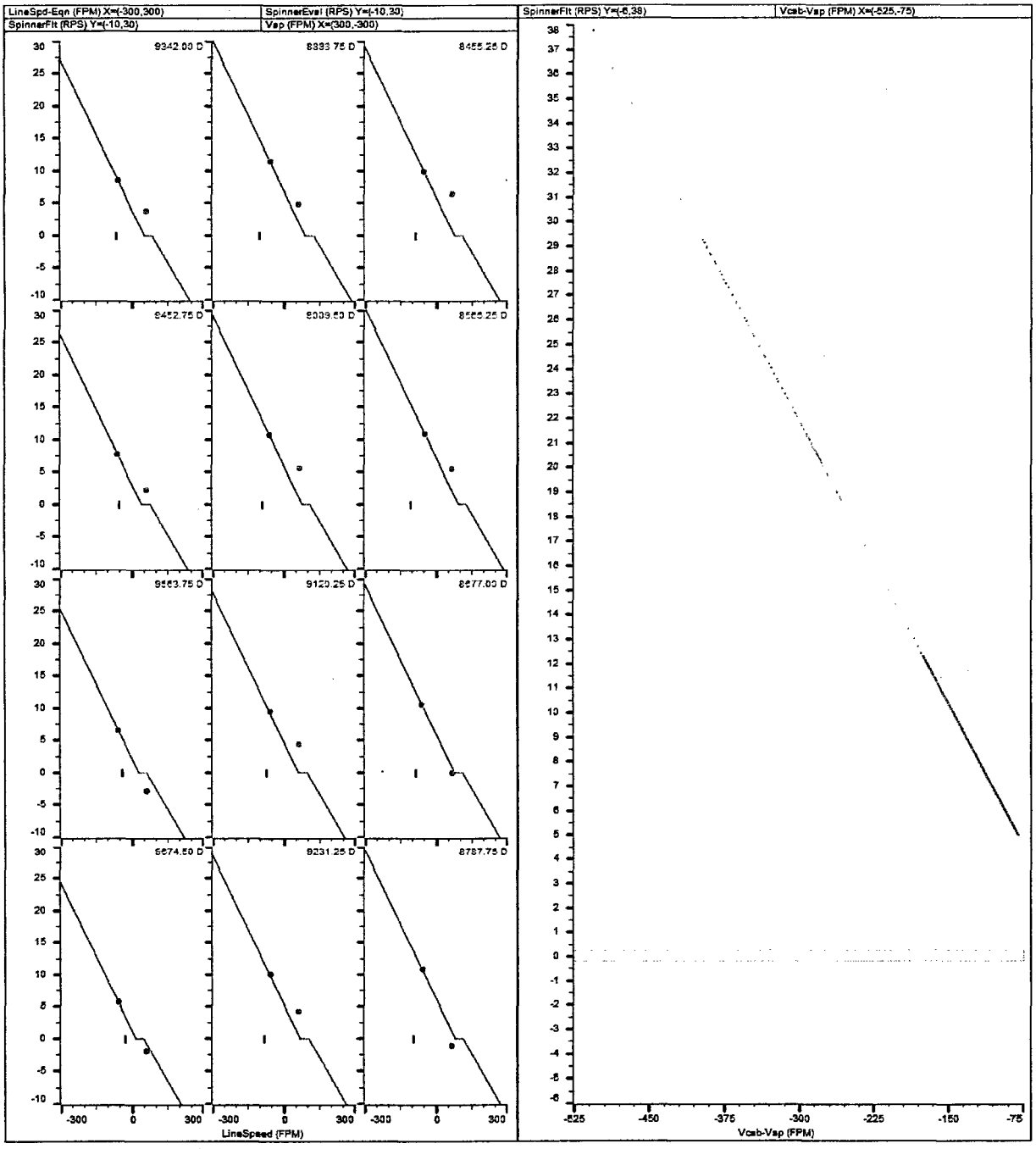
Overlay of all Log Data



Apparent Fluid Velocity Derived from Spinner

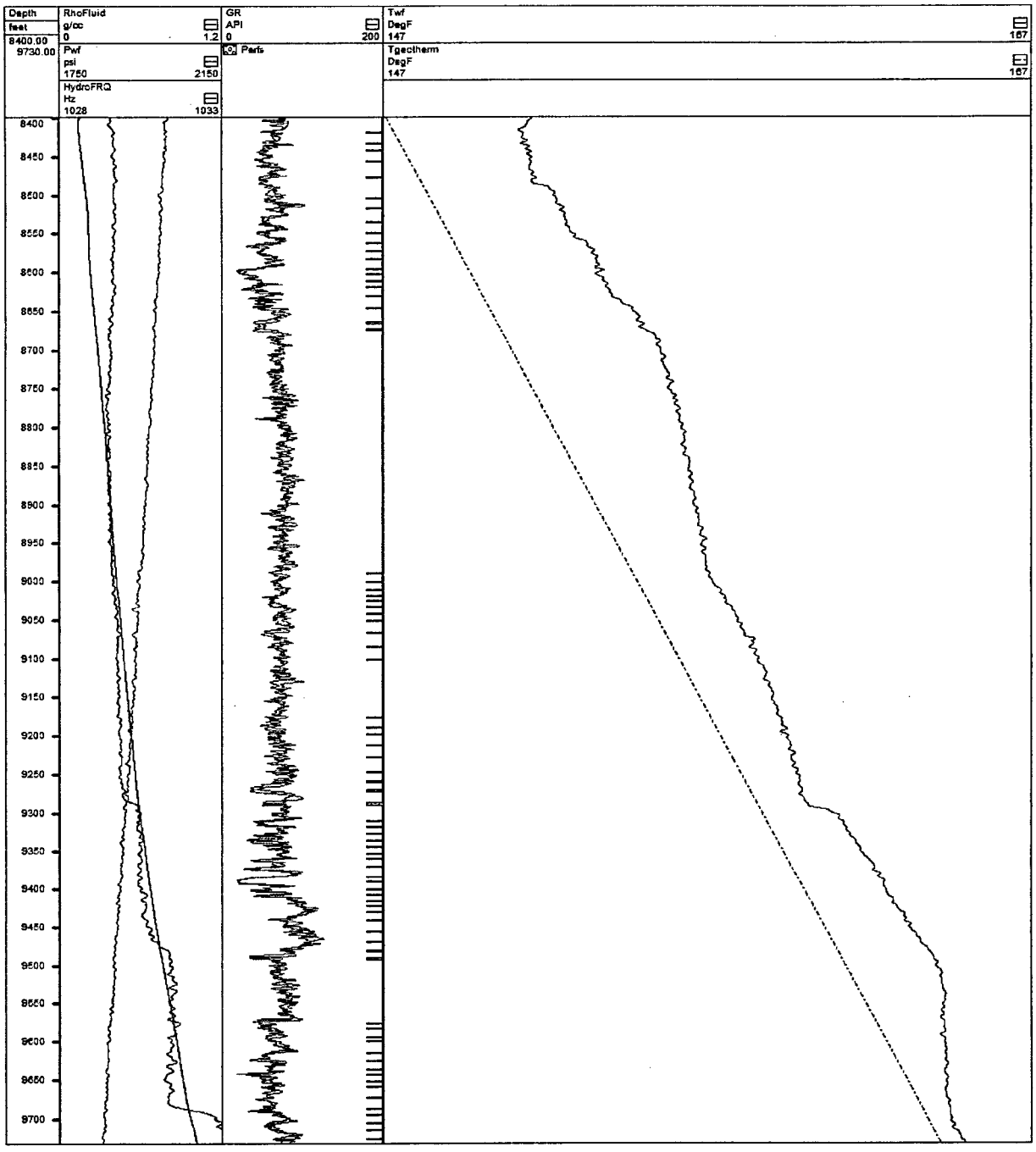


Spinner Calibration Plots
Relationship between R.P.S. and Fluid Velocity (fpm)



Completion Profile Analysis

Geothermal Gradient



Well Information
Parameters used for Analysis

SPGG	UNITY	.682
APIOil	UNITY	52.3
DPipe	in	4.00
PipeAngle	DegAng	14.7
Geotherm	°F/ft	.0129
TgeoRef	°F	164
DgeoRef	ft	9675

Downhole Measured and Computed Parameters

Depth	Pwf	Twf	ρ_{gas}	ρ_{oil}	ρ_{water}	RhoFluid	B_{gas}	Vap
feet	psi	DegF	g/cc	g/cc	g/cc	g/cc	UNITY	FPM
8400.00	1796	152	.0996	.740	1.01	.374	.00838	460
8495.00	1813	152	.100	.740	1.01	.399	.00831	78.7
8590.00	1823	154	.101	.739	1.01	.392	.00829	112
8685.00	1840	155	.101	.739	1.01	.358	.00825	101
8780.00	1857	156	.102	.738	1.01	.357	.00819	101
8875.00	1871	156	.103	.738	1.01	.374	.00813	108
8970.00	1885	157	.103	.738	1.01	.385	.00808	101
9065.00	1902	158	.104	.738	1.01	.431	.00803	85.6
9160.00	1919	159	.105	.737	1.01	.437	.00798	80.0
9255.00	1937	160	.105	.737	1.01	.449	.00792	83.4
9350.00	1961	162	.106	.736	1.01	.598	.00786	74.2
9445.00	1987	163	.107	.736	1.01	.644	.00778	61.9
9540.00	2019	164	.109	.736	1.01	.828	.00768	37.6
9635.00	2050	164	.110	.736	1.01	.823	.00756	21.6
9730.00	2089	165	.112	.735	1.01	1.38	.00743	32.9

Definitions

Curve Name	Description
Holdup	Holdups
PerfCount	Perforations
QGas	Total Gas Production at surface conditions
QpGas	Incremental Gas Production at surface conditions
QOil	Total Oil Production (if present downhole) at surface conditions
QpOil	Incremental Oil Production (if present downhole) at surface conditions
QWater	Total Water Production at surface conditions
QpWater	Incremental Water Production at surface conditions
GR	Gamma Ray/SpectraScan
Twf	Average Temperature
Vap	Apparent Velocity
Vap-Theo	Theoretical Apparent Velocity
Tgeotherm	Geothermal Gradient
RhoFluid	Average Fluid Density
Pwf	Average Pressure
HydroFrq	Average Fluid Dielectric
Flowrate	Total Flowrate at downhole conditions
Vap	Apparent Velocity
Vap-Theo	Theoretical Apparent Velocity
RhoFluid	Average Fluid Density
RhoFluid-Theo	Theoretical Average Fluid Density
DPwfDz	Differential Pressure
DPwfDz-Theo	Theoretical Differential Pressure
Twf	Average Temperature
Twf-Theo	Theoretical Average Temperature
Tgeotherm	Geothermal Gradient
DTwfDz	Differential Temperature
DTwfDz-Theo	Theoretical Differential Temperature
Regime	Flow Regimes
Temperature	Temperature Passes
Density	Fluid Density Passes
Spinner	Spinner Passes
Pressure	Pressure Passes
Linespeed	Linespeed Passes
Slope	Spinner Slope
Vthr	Spinner Threshold
SpinnerFlt	Spinner
DPipe	Inside diameter of the casing/tubing across logged interval
PipeAngle	Average pipe angle across logged interval
APIOil	Degree API of the oil
SPGG	Specific Gravity of the gas
TgeoRef	Reference Temperature for Geothermal Gradient calculations
DgeoRef	Reference Depth for Geothermal Gradient calculations
Goetherm	Geothermal Gradient across logged interval

Completion Profile Analysis

Tool Specifications

O.D.	1-11/16 in. (42.86 mm)
Length	11.9 ft.(3.63 m) in combination 23.28 ft. (7.1 m) stand alone
Pressure Rating	15,000 psi (103421.4 Kpa)
Temperature Rating	350°F (177°C)

Flow Measurement

Measurement of fluid velocity is made using the *Spinner Flowmeter*. This is calibrated by making logging passes at different line speeds to establish the relationship between instrument velocity in *feet/minute and the spinner response in* revolutions/second (RPS). With this relationship the measured RPS can be converted to fluid velocity in ft/minute. With a known pipe I. D. this can be used to calculate the flow rate in BPD.

$Q_{BPD} = ft/min \times 1.4 \times I.D.^2$

Mass flow rate can be computed using the *Temperature* data. This is based on an enthalpy model, taking into consideration; kinetic energy, frictional and Joule-Thompson heating as well as conduction and convection into the formation.

In gas wells the volumetric fraction of liquids (water) can be very small. Therefore water production may not be quantifiable by velocity measurement alone. Because of water's high mass relative to gas, mass flowrate computed from the *Temperature* data can be better at quantifying the water production.

Holdup Measurement

Holdup (γ) - The fraction of each phase in the wellbore (Water, Oil, Gas fraction) This should not be confused with *Cut*. i.e. 100% water holdup exists in the static rathole but does not flow.

The *Fluid Density* instrument uses a small gamma ray source and a gamma ray detector to measure the density of the wellbore fluid mixture. The mixture density is used to calculate the holdup fraction.

$\gamma_{water} = (\rho_{mixture} - \rho_{gas}) / (\rho_{water} - \rho_{gas})$

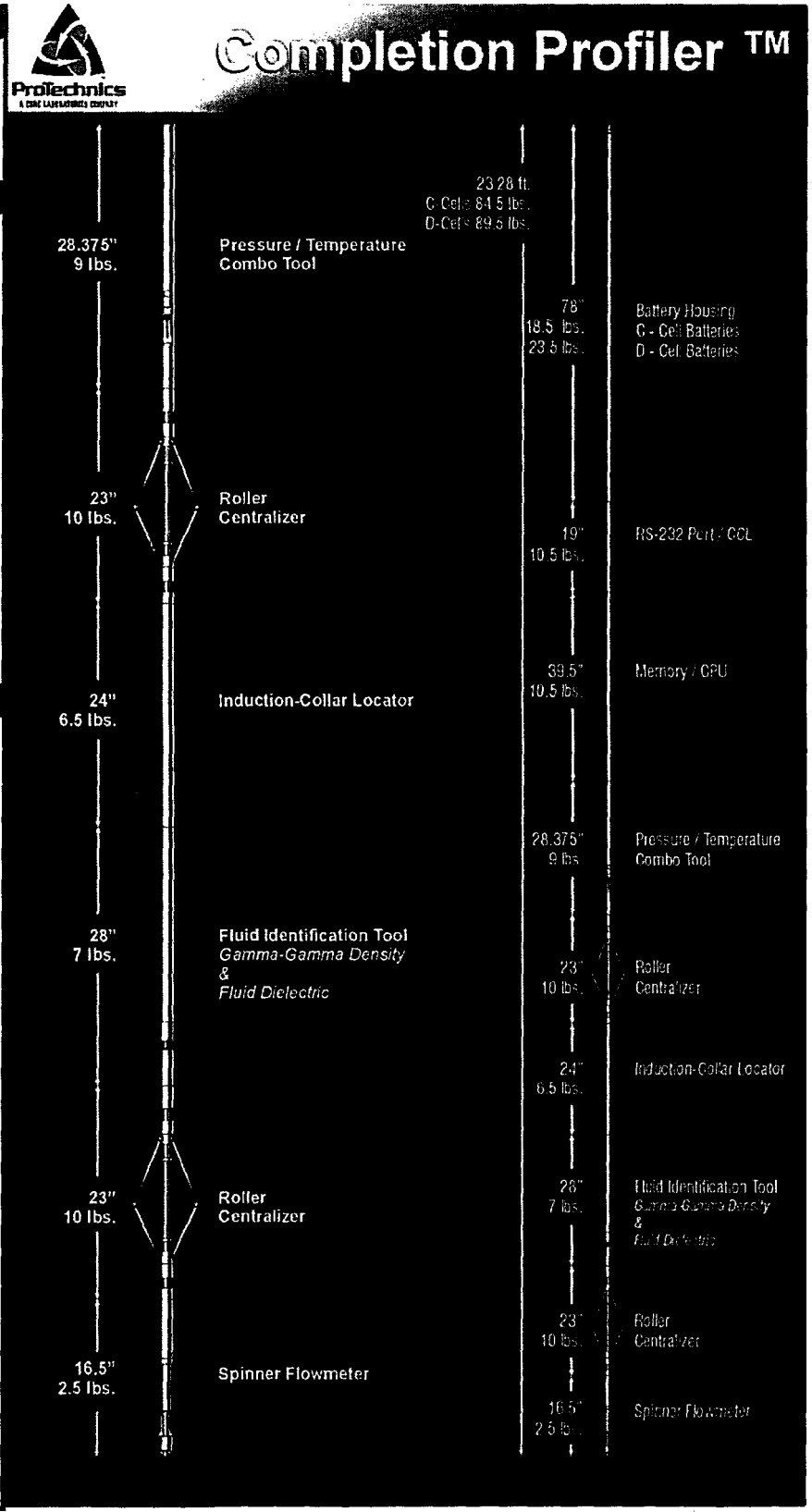
[For two-phase gas-water production]

ρ: density (gm/cc)

The *Fluid Dielectric* instrument works like an electric capacitor. The capacitor plates are exposed to the wellbore fluids and are a fixed size and distance apart. The value of the capacitance will change as the dielectric of the fluids between the plates change. The instrument response is then used to calculate the hydrocarbon and water fractions. This is possible because of the unique dielectric constant of water, oil and gas.
Water = 78, Oil = 4 and Gas = 1

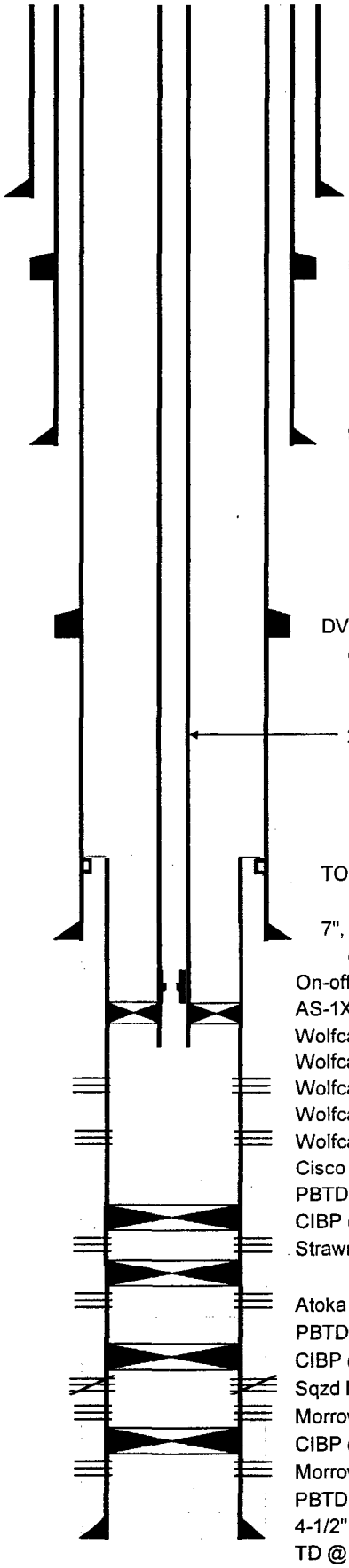
The *Pressure* data can also be used to corroborate the fluid holdup measurements. This is done by measuring the pressure gradient or the derivative of the pressure curve with respect to depth. The resulting curve in psi/ft can be used to determine the water and gas fractions.

Note:
In three phase flow both fluid density and dielectric measurements are necessary. The dielectric is used to determine the water holdup then the density is used to calculate the remaining gas and oil holdups.



CIMAREX

Cimarex Energy Co. of Colorado
Estill AD Federal #2
SHL - 2270' FNL & 380' FEL
BHL - 1588' FNL & 957' FEL
Sec. 19, T-24-S, R-26-E, Eddy Co., NM
S. Runyan 7/20/2017



KB - 23' above GL

13-3/8", 54.5# J-55 csg @ 352'
cmtd w/ 450 sx, cmt circ

DV Tool @ 1017'
cmtd w/ 410 sx, 1" to surface w/ 638 sx

9-5/8", 40# NS-110HC csg @ 1567'
cmtd w/ 170 sx, cmt circ

DV Tool @ 4809'
cmtd w/ 575 sx, cmt circ

2-3/8" 4.7# L-80 8rd EUE Tbg

TOL @ 7247'

7", 23# NS-110HC csg @ 8012'
cmtd w/ 400 sx, cmt circ

On-off Tool w/ 1.875" Profile Nipple @ 8,361'
AS-1X pkr @ +/- 8368'
Wolfcamp perfs (8418' - 8675')
Wolfcamp perfs (8989' - 9290')
Wolfcamp perfs (9310' - 9493')
Wolfcamp perfs (9575' - 9736')
Wolfcamp perfs (9756' - 9915')
Cisco Canyon perfs (9947' - 10,215')
PBTD @ 10365'
CIBP @ 10400'
Strawn perfs (10441' - 10451')

Atoka perfs (11076' - 11090')
PBTD @ 11515'
CIBP @ 11550'
Sqzd Morrow perfs (11600' - 11616')
Morrow perfs (11706' - 11718')
CIBP @ 11850'
Morrow perfs (11911' - 11968')
PBTD @ 12250'
4-1/2" 11.6# HCP-110 FJ @ 12300' cmtd w/ 475 sx
TD @ 12300'

Printed 8/30/2017